Ongoing Efforts on Precipitation Dataset Assessment

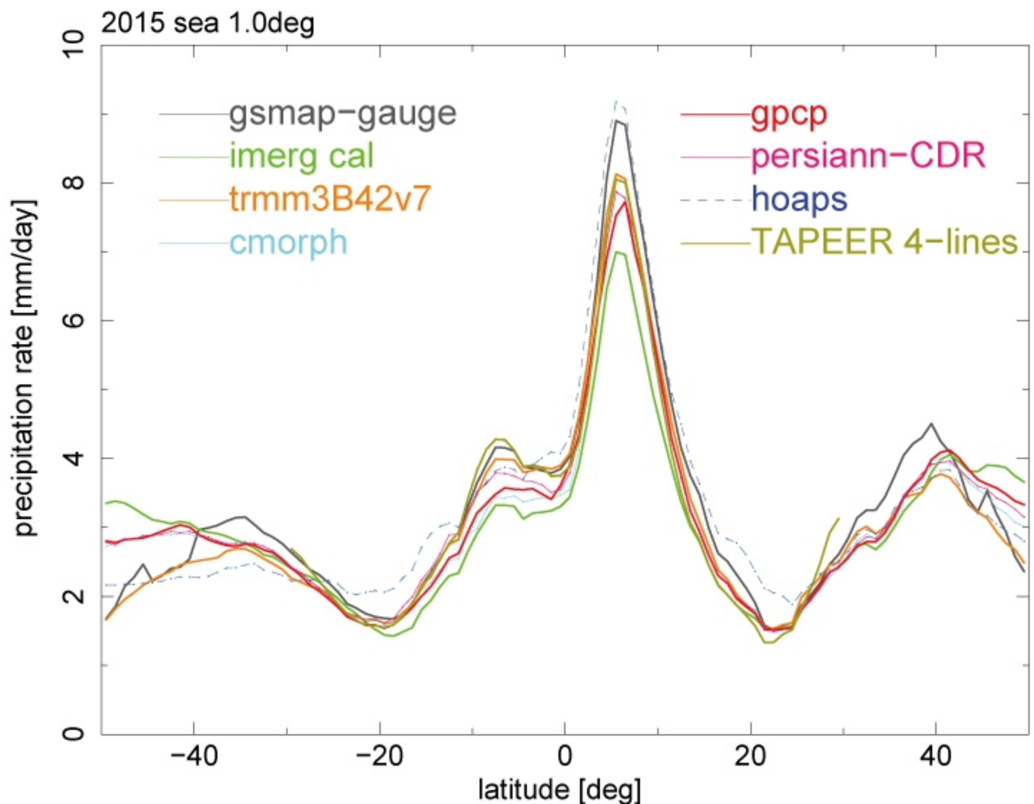
Hiro Masunaga (Nagoya University)

With thanks to Fumie Akimoto, Marc Schröder, Rémy Roca, and Chris Kummerow

Do we know how much precipitation falls on the Earth?

Yes, but the answer depends on whom you ask.

Do we know how much precipitation falls on the Earth?



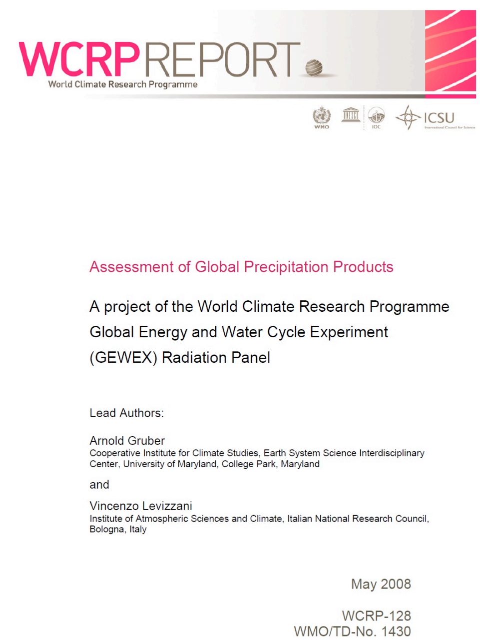
2015 annual mean over oceans

Precipitation Assessment

- GEWEX Data and Analysis Panal (GDAP)
  1st Precipitation Assessment was
  published in 2008.

- GDAP decided in 2014 to launch
  a new precipitation assessment.

- A joint GDAP-IPWG precipitation
  assessment started in 2018.


WCRP REPORT
World Climate Research Programme

ICSU

Assessment of Global Precipitation Products

A project of the World Climate Research Programme Global Energy and Water Cycle Experiment (GEWEX) Radiation Panel

Lead Authors:

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and

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May 2008

WCRP-128
WMO/TD-No. 1430

Proposed elements of GDAP-IPWG Precipitation Assessment (as of May 2018)

#	Name	Leads	Short description
1	Standard quality assessment	T. Kubota and H. Masunaga	catalogue with summary descriptions; intercomparisons as close to product spatial and temporal resolution as possible; regime sorted statistics;quality & traceability (including WDAC doc+ FIDUCEO)
2	Uncertainty	J. Turk and P. Kirstetter	uncertainty metrics (detection, estimation); intrinsic uncertainty (sensitivity); algorithm limitations;
3	Consistency	A. Behrangi and D.B. Shin	water and energy budgets consistency; regional budgets; ancillary datasets (description and assessment for robustness)
4	Evaluation of analysis data from numerical models	H.J. Kim and G. Balsamo	performance metrics; model scales (spatial and temporal)
5	Ground based data	C. Kidd and S. Durden	sources (including weather radar where available); calibration and uncertainty characterization of sources, including polarimetric ground radars
6	Validation at weather scales in regions without ground measurements	R. Ferraro	consistency with other remotely sensed data at weather scales; consistency with reanalysis; intrinsic similarity with regions with GV
7	Variability and trends	F.J. Tapiador and Giong Gu	sub-seasonal, seasonal, annual, inter-annual; extremes and the ability to capture them faithfully; correlation with climate indices; methods for identification of trends
8	End users applications	Z. Haddad and G. Huffman	phenomenological assessment (consistency with agricultural indices); metrics for the
9	Recommendations to algorithms developpers	G. Huffman and Z. Haddad	assessment of assumptions underlying the algorithms , including retrievals from ground measurements (physical validation);
10	Programmatic recommendations	G. Stephens and V. Levizzani	product sensitivity to satellite constellation configuration; sensitivity to instrument capability and performance , including ground /airborne instruments product sensitivity to satellite constellation configuration; sensitivity to instrument capability and performance , including ground/airborne instruments
11	Extremes rainfall	Roca (TBC)	A dedicated and focused assessment on extreme precipitation. It will outreach to the various groups above. The organisation is currentmly under the lead of R. Roca who is co-organizing with the WCRP Grand Challenge on extremes and GDAP a meeting to elaborate in July on this activity. It will includes remote sensing, ground based and models.
12	Assessment information management and development	Zhong Liu	Engage precipitation data users by developing a system that includes standard GV methods (TBD) and allows them to use the system for comparison, at the same time allowing us to better understand product performance and use the results for improvements.

I know this is completely illegible. Just intended to impress the audience.

Related activities

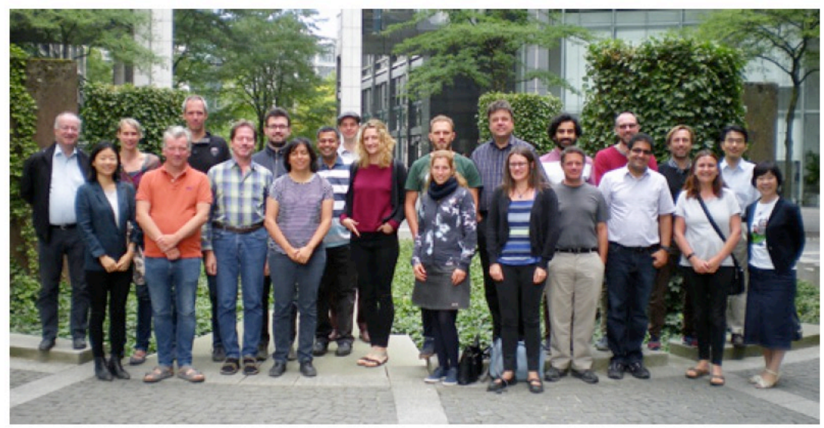
Joint WCRP Grand Challenge/GDAP Workshop on Extremes

- Held in Offenback, Germanny, in July 2018
- Participants prepared an outline for a special issue on precip extremes in Environmenal Research Letters (ERL)

Joint WCRP Grand Challenge on Weather and Climate Extremes/GEWEX GDAP Workshop on Precipitation Extremes

DWD, Offenbach, Germany
9–11 July 2018

Lisa Alexander[1], Rémy Roca[2], Sonia Seneviratne[3], Andreas Becker[4], Ali Behrangi[5], Steefan Contractor[1], Felix Dietzsch[4], Markus Donat[1], Robert Dunn[6], Hayley Fowler[7], Chris Funk[8], Adrien Guérou[9], Rainer Hol-lmann[4], Pierre Kirstetter[10], Katharina Lengfeld[4], Maarit Lockhoff[4], Hirohiko Masunanga[11], Heewon Moon[3], Caroline Muller[9], Marc Schroeder[4], Udo Schneider[4], Yukari Takayabu[12], V. Venugopal[13], Martin Werscheck[4]



From GEWEX NEWS, Aug. 2018 issue

FROGS data archives (poster by Rémy yesterday)

- Frequent Rainfall Observations on GridS (FROGS)

FROGS: a daily 1° × 1° gridded precipitation database of rain gauge, satellite and reanalysis products

Rémy Roca[1], Lisa V. Alexander[2,3], Gerald Potter[4], Margot Bador[2,3], Rômulo Jucá[5], Steefan Contractor[2,6], Michael G. Bosilovich[4], and Sophie Cloché[7]

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Received: 19 March 2019 – Discussion s
Revised: 14 June 2019 – Accepted: 20 June 20

Product short name and version	Period used	Spatial coverage	References
CPC	1979–2017	60° S–90° N	Xie et al. (2010)
GPCC Full Daily v2018	1982–2016	60° S–90° N	Ziese et al. (2018)
GPCC Full Daily v1	1982–2013	60° S–90° N	Becker et al. (2013)
GPCC First Guess v1	2009–2016	60° S–90° N	Becker et al. (2013)
REGEN All V1-2019	1950–2016	60° S–90° N	Contractor et al. (2019)
REGEN Long V1-2019	1950–2016	60° S–90° N	Contractor et al. (2019)

Product short name and version	Period used	Spatial coverage	Use of rain gauge data	Use of IR satellite data	Use of MW satellite data rainfall estimate	Main scientific references and ATBD
Satellite-based quasi-global						
3B42 v7.0	1998–2016	50° S–50° N	yes	yes	multiple platforms	Huffman et al. (2007)
3B42 v7.0 IR	1998–2016	50° S–50° N	no	yes	no	Huffman et al. (2007)
3B42 v7.0 MW	1998–2016	50° S–50° N	no	no	yes	Huffman et al. (2007)
3B42 RT v7.0	2000–2017	50° S–50° N	yes	yes	multiple platforms	Huffman et al. (2007)
3B42 RT v7.0 uncalibrated	2000–2017	50° S–50° N	no	yes	multiple platforms	Huffman et al. (2007)
GSMaP-RNL-gauge v6.0	2001–2013	50° S–50° N	yes	yes	multiple platforms	Kubota et al. (2007)
GSMaP-RNL-no gauge v6.0	2001–2013	50° S–50° N	no	yes	multiple platforms	Kubota et al. (2007)
GSMaP-NRT-gauge v6.0	2001–2017	50° S–50° N	yes	yes	multiple platforms	Kubota et al. (2007)
GSMaP-NRT-no gauge v6.0	2001–2017	50° S–50° N	no	yes	multiple platforms	Kubota et al. (2007)
PERSIANN CDR v1 r1	1983–2017	50° S–50° N	yes	yes	no	Ashouri et al. (2015), Sorooshian et al. (2014)
CMORPH V1.0, RAW	1998–2017	60° S–60° N	no	yes	multiple platforms	Xie et al. (2017)
CMORPH V1.0, CRT	1998–2017	60° S–60° N	yes	yes	multiple platforms	Xie et al. (2017)
GPCP 1DD CDR v1.3	1997–2017	90° S–90° N	yes	yes	one platform	Huffman et al. (2001)
Land only						
CHIRPS v2.0	1981–2016	50° S–50° N Land only	yes	yes	no	Funk et al. (2015)
CHIRP v2.0	1981–2016	50° S–50° N Land only	yes	yes	no	Funk et al. (2015)
SM2RAIN-CCI	1998–2015	Global Land only	no	no	no	Ciabatta et al. (2018)
Ocean only						
HOAPS	1996-2014	ocean only	no	no	multiple platforms	Andersson et al. (2017)
Satellite-based regional						
TAPEER v1.5	2012–2016	30° S–30° N	no	yes	multiple platforms	Roca et al. (2018)
TAMSAT v2	1983–2017	Africa (land only)	yes	yes	no	Maidment et al. (2017)
TAMSAT v3	1983–2017	Africa (land only)	yes	yes	no	Maidment et al. (2017)
ARC v2	1983–2017	Africa (land only)	yes	yes	no	Novella and Thiaw (2013)
COSH	2000–2018	60° S–33° N 120–30° W	yes	yes	yes	Vila et al. (2009)

A paper under review for the ERL special issue

Inter-product biases in global precipitation extremes

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Abstract

Biases in climatological and extreme precipitation estimates are assessed for 11 global observational datasets constructed with merged satellite measurements and/or rain gauge networks. Specifically, the biases in extreme precipitation are contrasted with mean-state biases. Extreme precipitation is defined by a 99th percentile threshold (R99p) on a daily, $1°\times1°$ grid for 50°S-50°N. The spatial pattern of extreme precipitation lacks distinct features such as the ITCZ that is evident in the global climatological map, and the climatology and extremes share little in common in terms of the spatial characteristics of inter-product biases. The time series also exhibit a larger spread in the extremes than in the climatology. Further, when analysed from 2001 to 2013, they show a relatively consistent decadal stability in the climatology over ocean while the dispersion is larger for the extremes over ocean. This contrast is not observed over land. Overall, the results suggest that the inter-product biases apparent in the climatology are a poor predictor of the extreme-precipitation biases even in a qualitative sense.

Keywords: climate extremes, global precipitation, satellite meteorology, rain-gauge networks

List of the products analyzed in this work

Satellite-based products

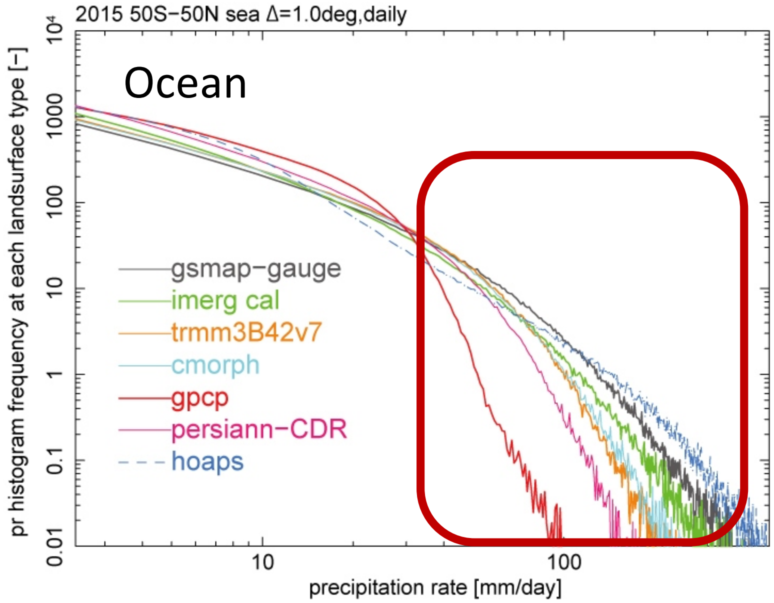
Gauge

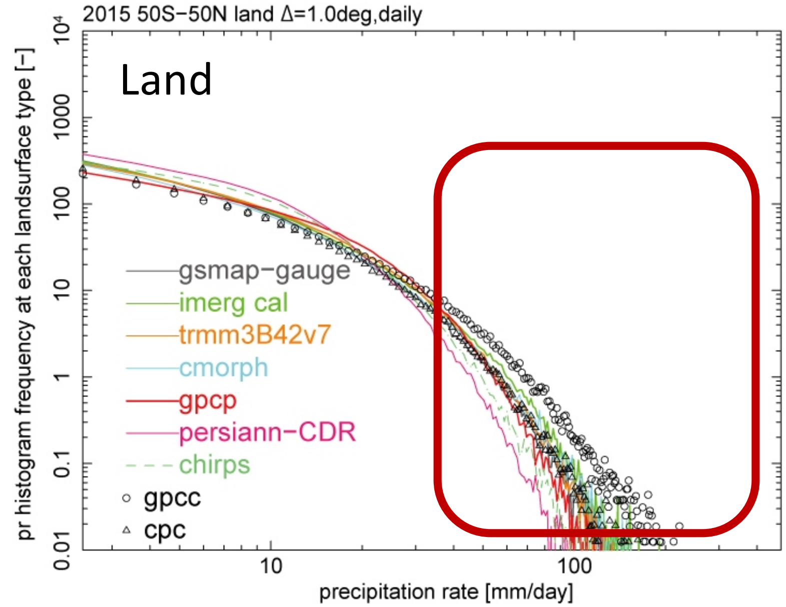
PRODUCT	downloaded data time range	plotted time range	version
GSMaP[a]	201403–201712	201403–201712	V05−V7.0001-v7.1002
	200003–201701	200003–201701	V04−V6.2123,6.4133,6.5133
	NRT:201702–201711	NRT:201702	V05−V7
	NRT:200811–201711	NRT:2015,201702	V04−V6(no-gauge)
IMERG[b]	201403–201801	201501–~~12~~-201712	V05A,B(1411–)
	201403–201702	201403–201702	V04A
	201501,201508	201501,201508	V03D
TRMM3B42[c]	199801-201712	199801-201712	V7
CMORPH[d]	199801–201712(RAW は 201707 まで)	1998-2017	V1.0
	(8km30min:1998–2017)		
GPCP[e]	monthly:197901–201712	monthly:1998–2017	V2.3
	daily:199610–201608	daily:199801–201608	V2.3
	daily:201501–201712	daily:201501–201712	V1.3
CMAP[f]	monthly:1979–2017	monthly:1998–2017	V1604,1703,1805
PERSIANN[g]	3hrly:200003–201712	3hrly:200101–201712	m6s4
	CDR:198301–201712	CDR:1998–201712	m6s4
HOAPS[h]	201501–201512	201501–201502	V4.0 (6hr,1mo)
	198707–200812	199801–200812	V3.2
meghatropiques[i]	201201–201712(途中)	201201–201712(途中)	V1.00
CHIRPS[j]	198101–201804	199801–201712	V2.0
CPC[k]	199801–200512(V1.0)	199801–200512	V1.0
	200601–201712(V1.0RT)	200601–201712	V1.0RT
GPCC[l]	190101–201312(full)	1998–2013	full−V7
	201401–201802(monitor–V5):	201401–201712	monitor−V5
	200701–201612(monitor–V4)	2014–2016	monitor−V4
meghatropiques(TAPEER)			

All products are available for the year of 2015.
Most products are available for 3 years of 2015-17

Histogram: 50°S-50°N

- 1°×1°, daily rain histogram for selected products
  - 2015 statistics

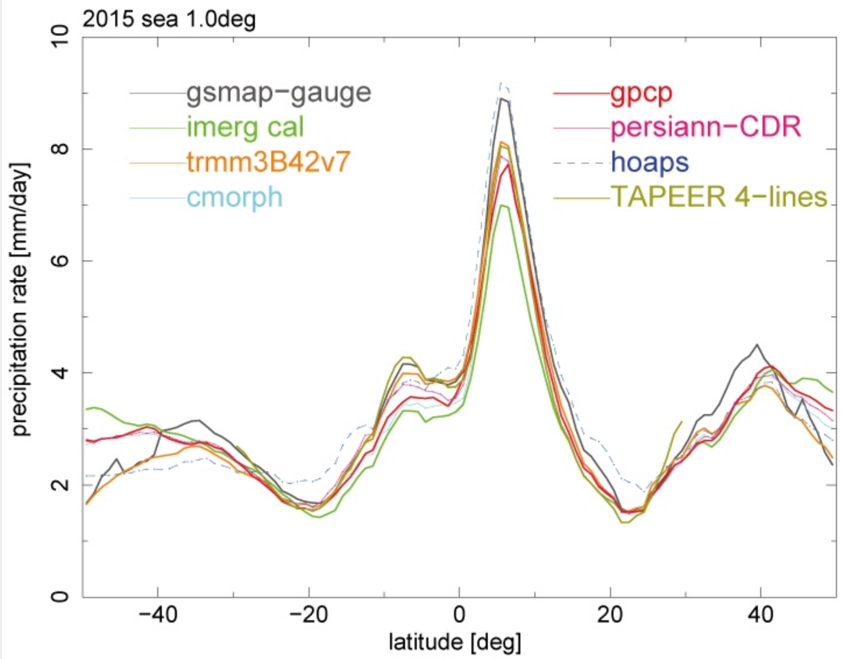




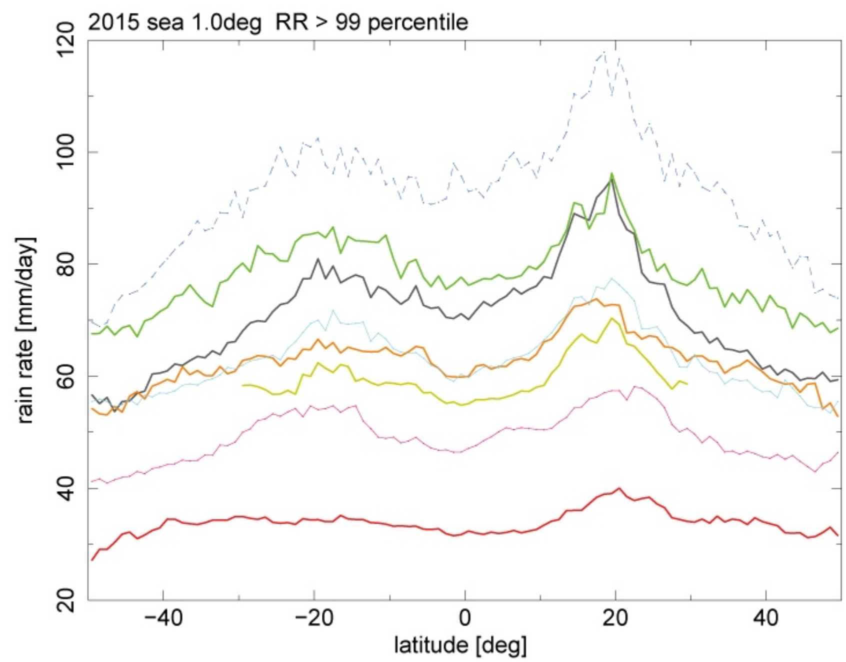
Climatology versus extremes

- Zonal mean over ocean (1°×1°, 2015 annual mean)

Climatology



Extremes (>99th percentile)

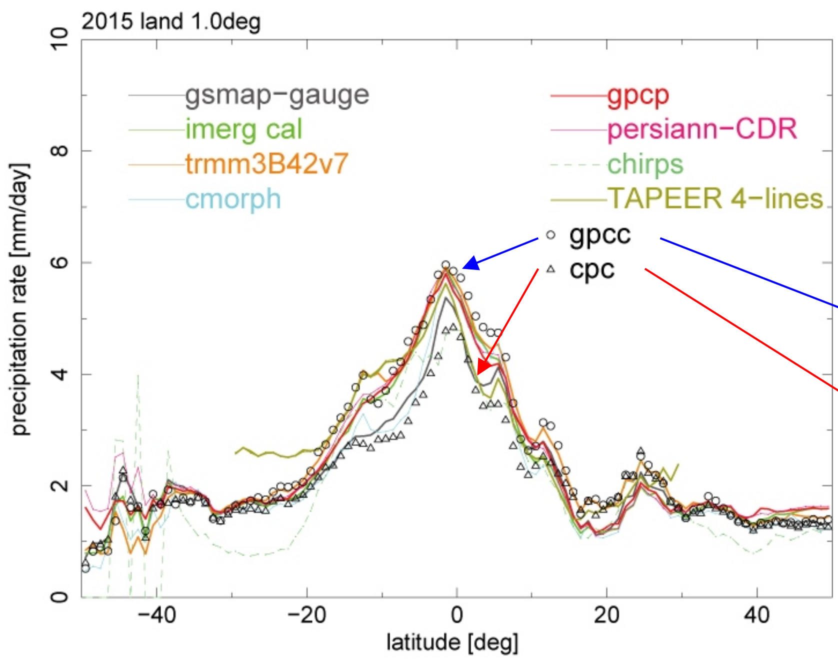


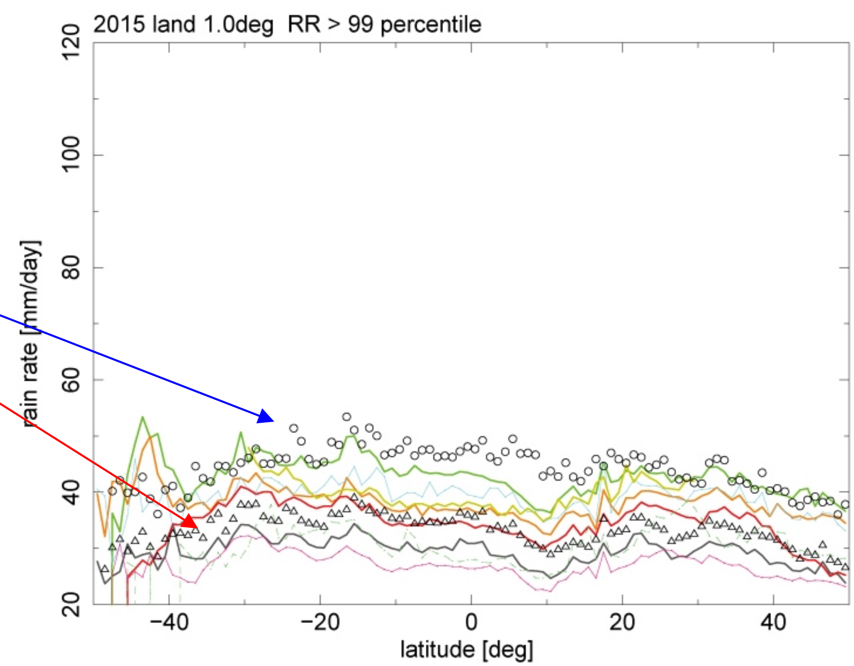
Climatology versus extremes

- Zonal mean over land (1°×1°, 2015 annual mean)

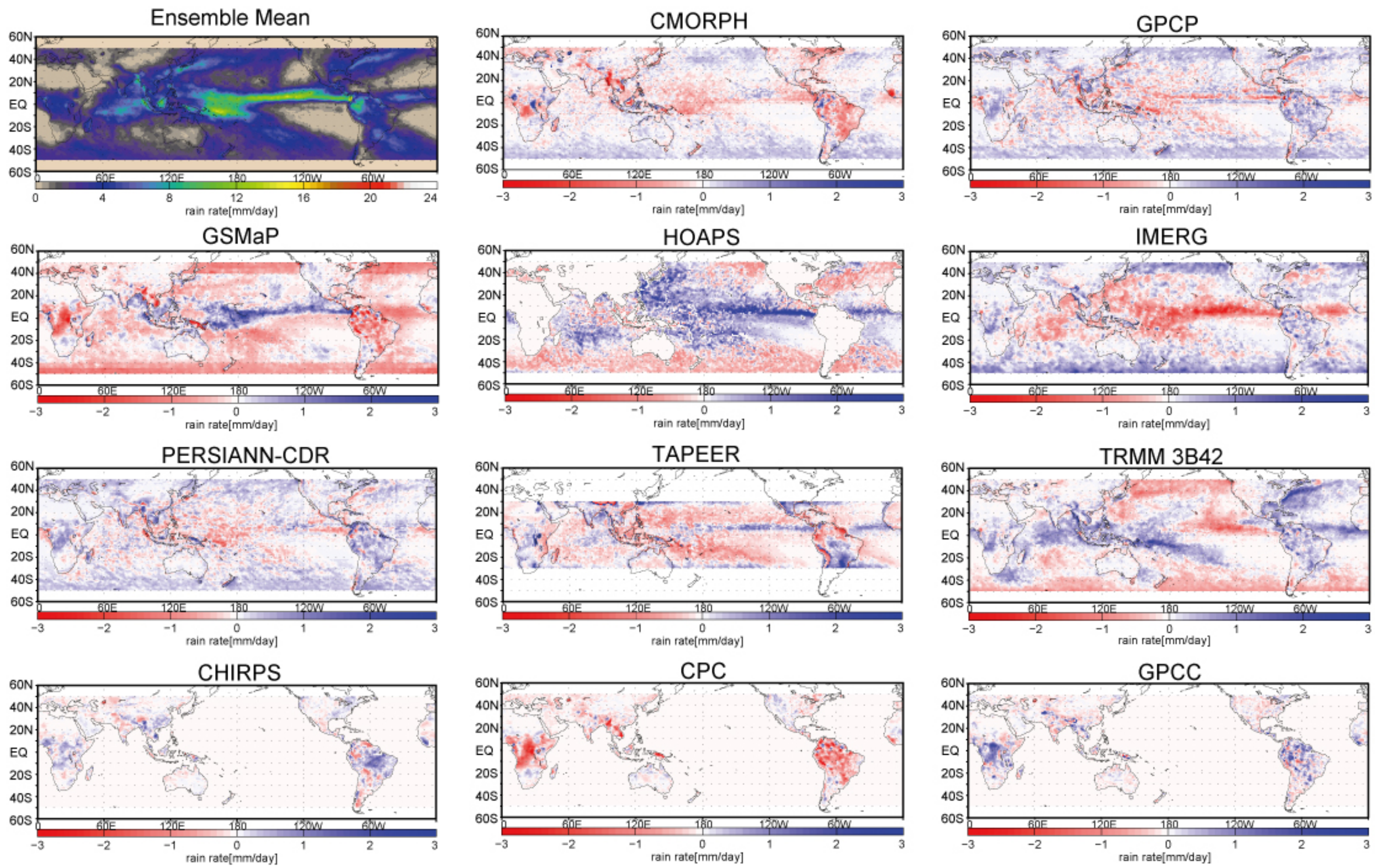
Climatology

Extremes (>99th percentile)

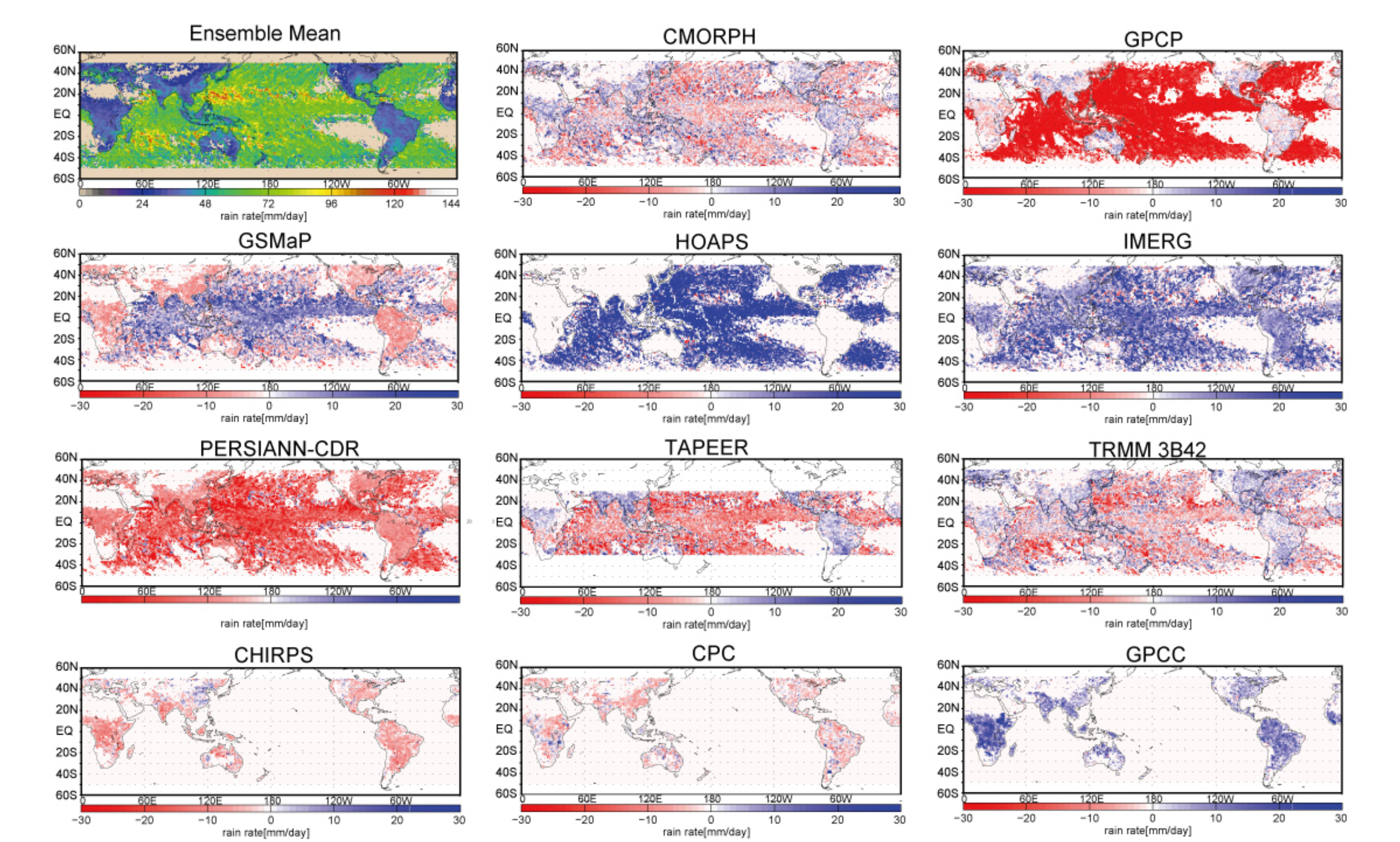




Climatology: Global maps

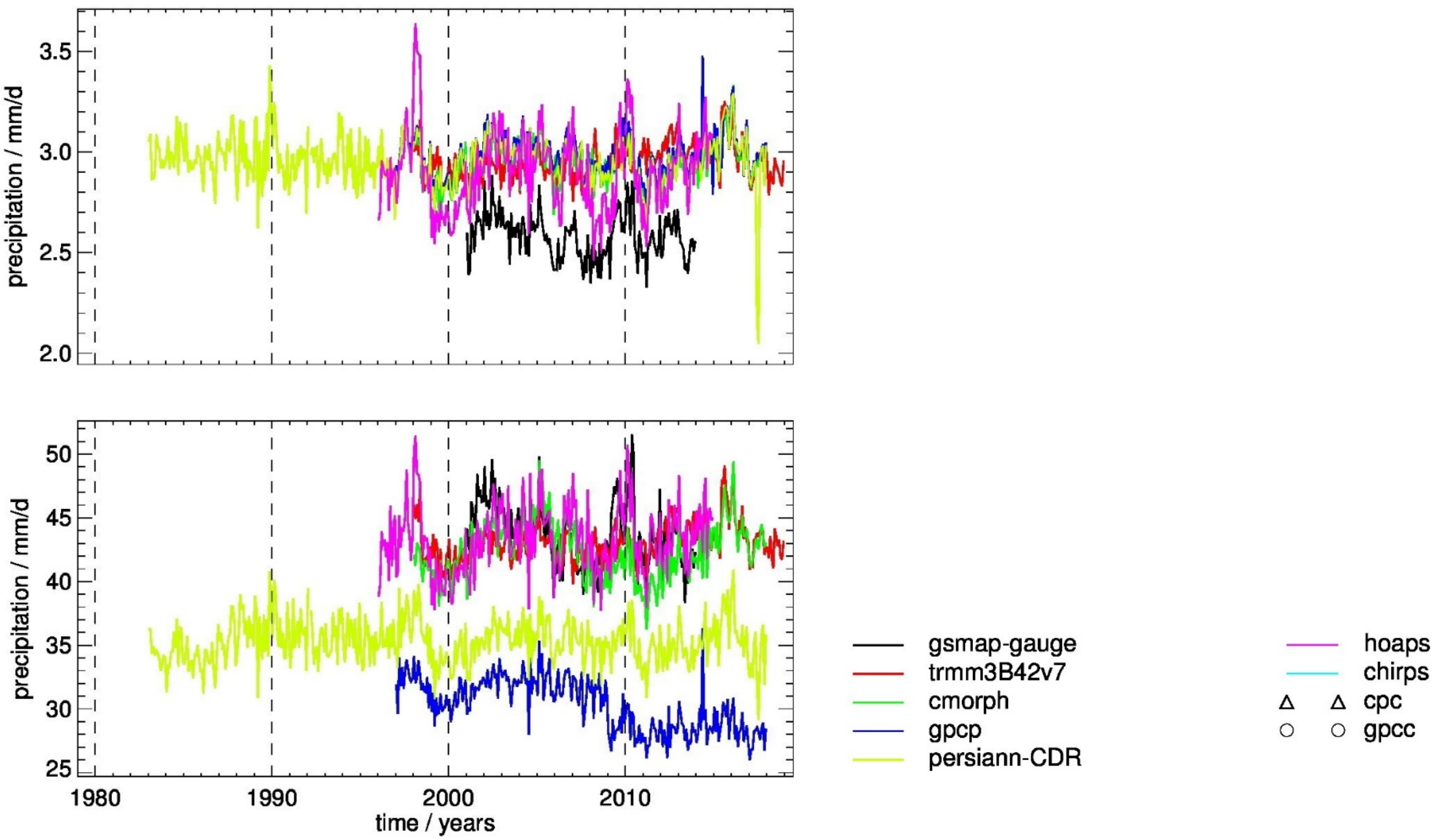


Extremes: Global maps



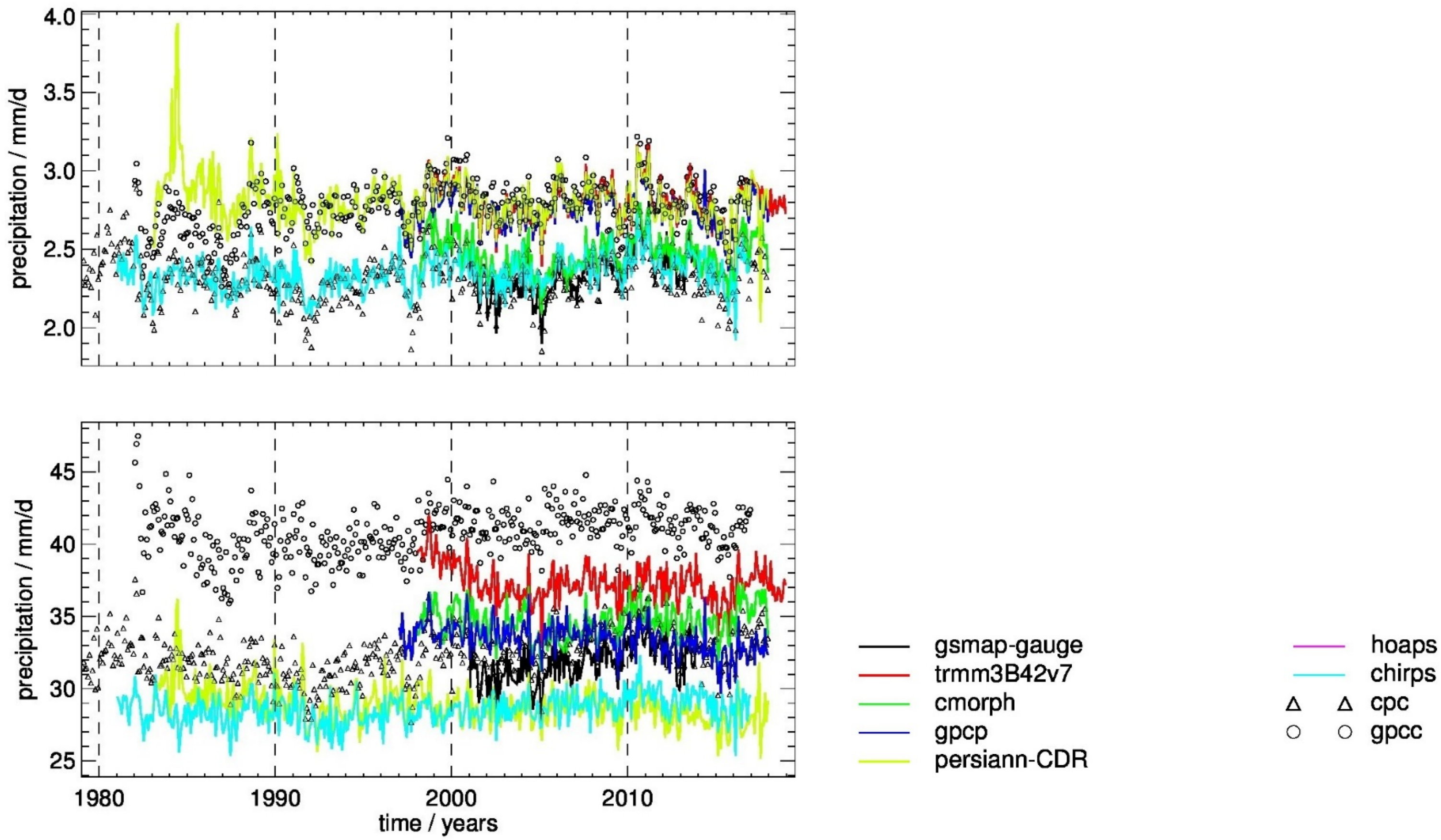
Year-to-yer variability

- Climatology (top) and extreme (bottom) over oceans



Year-to-yer variability

- Climatology (top) and extreme (bottom) over land



Summary

- GDAP/IPWG Precipitation Assessment
  - An extensive effort recently started to assess precipitation datasets
    - Since the 2014 GDAP meeting and the 2018 IPWG meeting
    - Next meetings: GDAP in Jan 2020 and IPWG in Jun 2020
  - Related activities
    - WCRP/GDAP meeting and ERL special issue on climate extremes
    - FROGS archives for facilitating inter-comparisons/assessments
  - Preliminary studies are underway.
    - Climatology vs. extremes: error charactersitics are qualitatively different.